(12) UK Patent Application (19) GB (11) 2 232 209 (13) A

(43) Date of A publication 05.12.1990

(21) Application No 9011445.5

(22) Date of filing 22.05.1990

(30) Priority data
(31) 01128777 (32) 24.05.1989 (33) JP

(51) INT CL[5]
F02N 15/06

(52) UK CL (Edition K)
F1K KCB K4A5B2

(56) Documents cited
GB 2193763 A

(58) Field of search
UK CL (Edition K) F1K
INT CL[5] F02N

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(54) Structure to prevent contamination of a sliding member support

(57) An air reservoir 19 between the starter pinion support bearing 17 and the housing wall defining the opening 18 through which the pinion 16 is projected communicates with the chamber 20 containing the one-way clutch 8 through a passage 21. The chamber 20 communicates with the atmosphere through a port 20. The arrangement reduces the flow of contaminated air over the bearing when the pinion is rotated. A stainless steel plate 23 protects the bearing 17 and a notch 24 permits draining of liquid and dust.

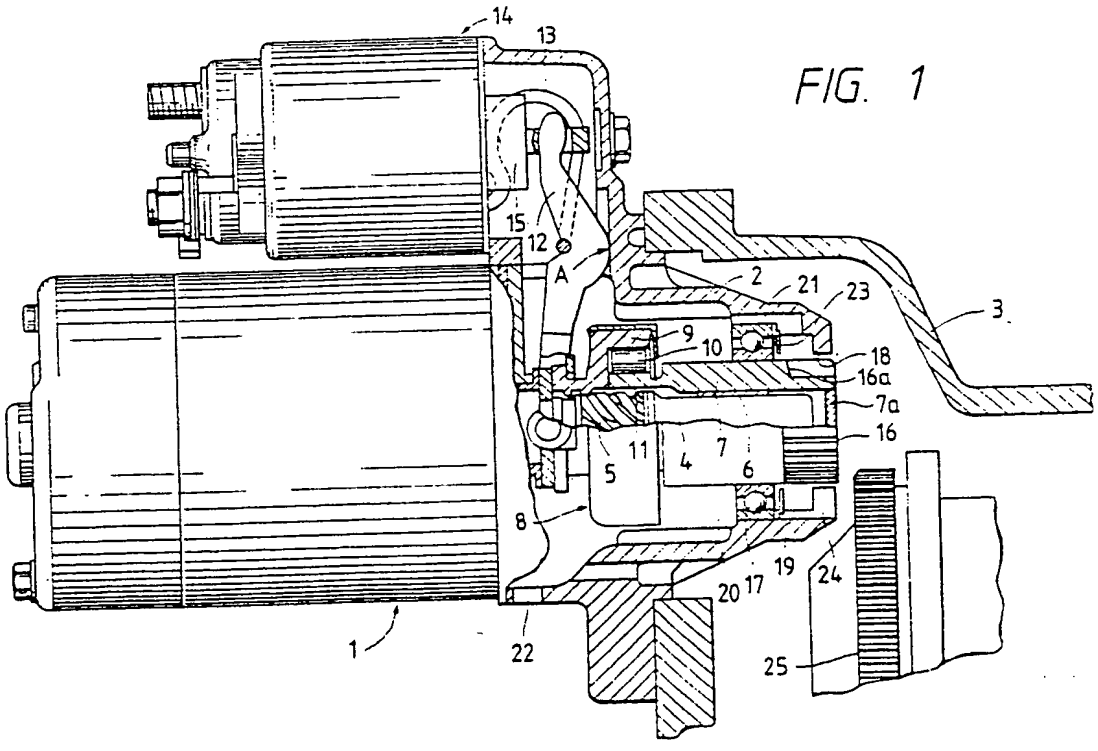


FIG. 1

FIG. 1

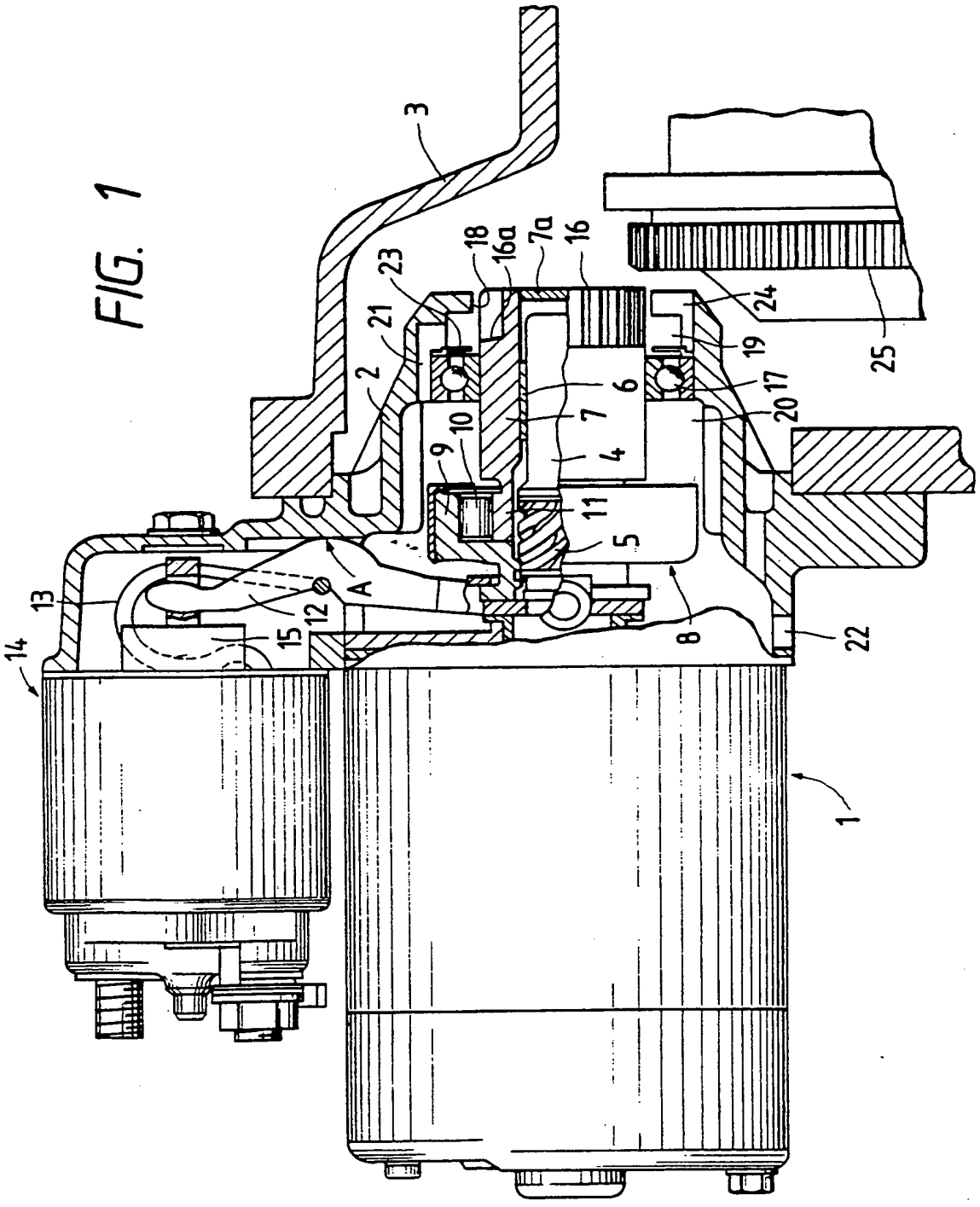


FIG. 2

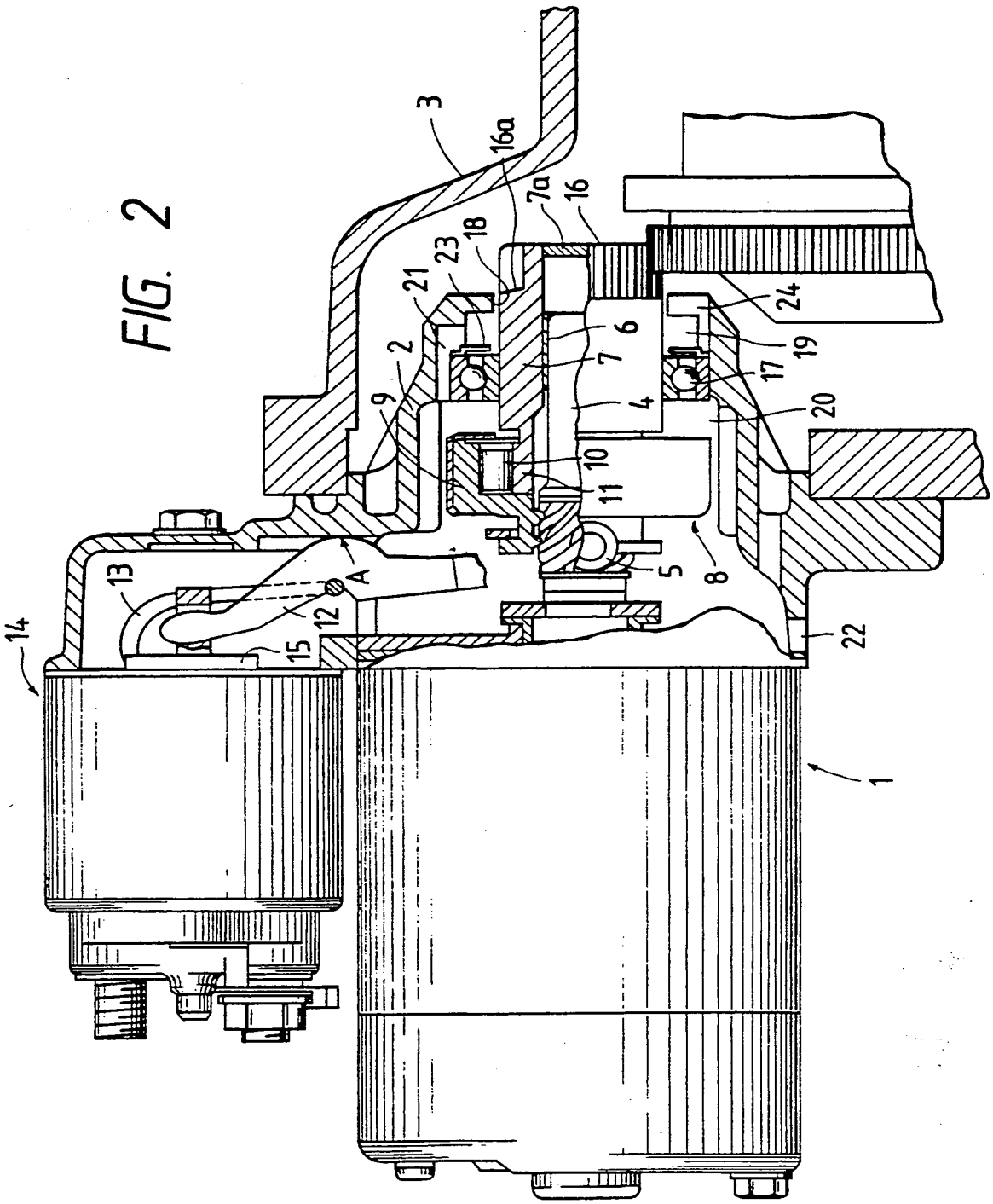


FIG. 3

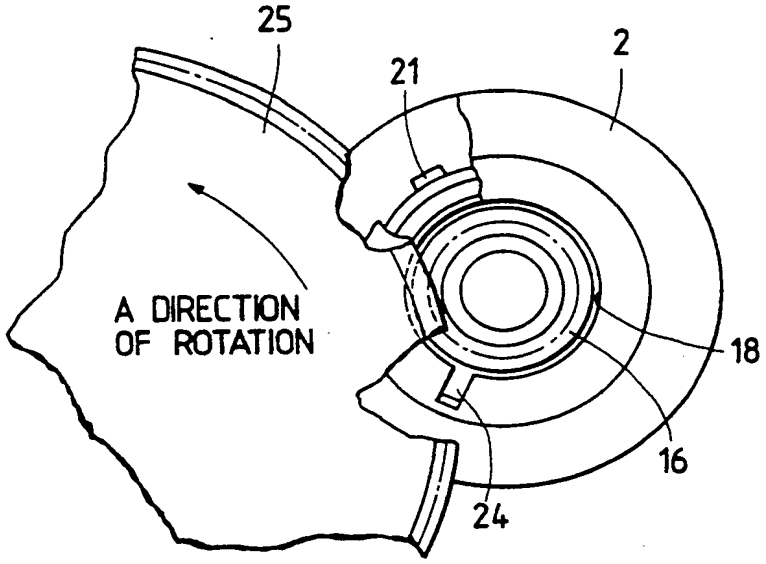

25
21
2
A DIRECTION
OF ROTATION
18
16
24

FIG. 4

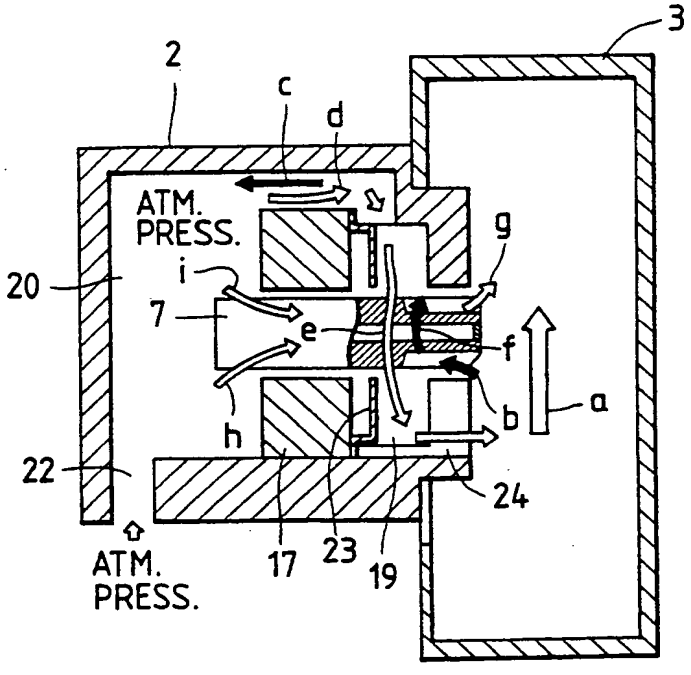

3
2
c
d
ATM.
PRESS.
g
20
i
7
e
f
a
b
h
22
24
ATM.
PRESS.
17
23
19

FIG. 5

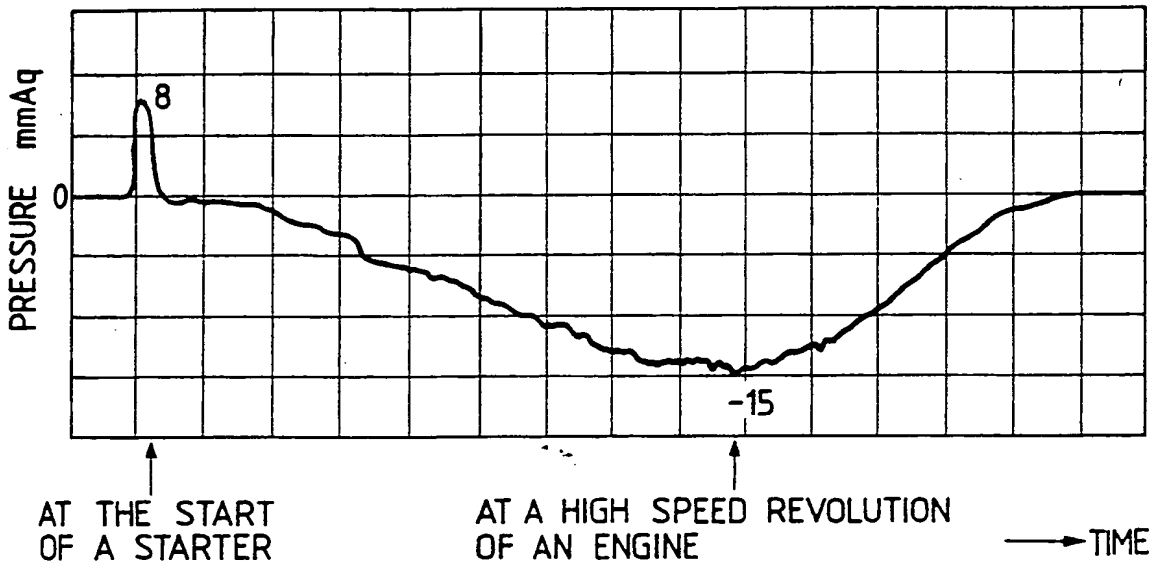

PRESSURE mmAq
8
0
-15
AT THE START OF A STARTER
AT A HIGH SPEED REVOLUTION OF AN ENGINE
TIME

FIG. 6

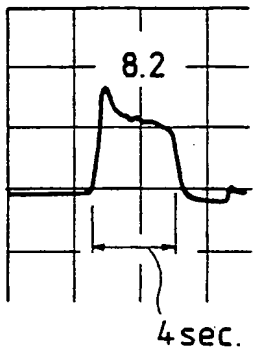

8.2
4sec.

FIG. 7

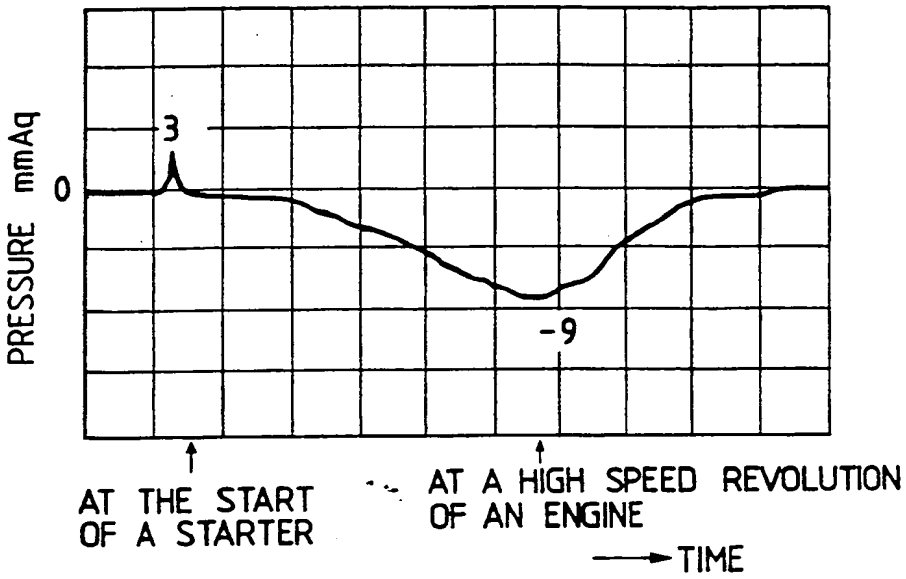
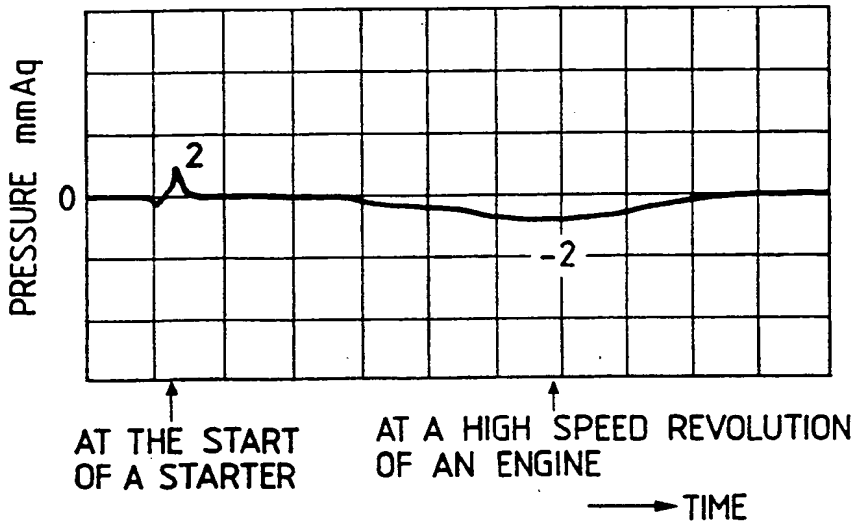

PRESSURE mmAq
0
3
-9
AT THE START OF A STARTER
AT A HIGH SPEED REVOLUTION OF AN ENGINE
TIME

FIG. 8


PRESSURE mmAq
0
2
-2
AT THE START OF A STARTER
AT A HIGH SPEED REVOLUTION OF AN ENGINE
TIME

Title of the Invention

A STARTER HAVING A CONTAMINANT-PROOF STRUCTURE OF A SLIDING PORTION

Background of the Invention

This invention relates to a starter for starting an engine such as an automobile internal combustion engine and, more particularly, to a structure for preventing a sliding portion from being contaminated with dust, water, brine, etc., and from rust occurrence, and a starter employing such a structure.

In general, a conventional starter for starting engines comprises a motor, a motor housing, a pinion shaft disposed in the motor housing and slidably supported by a ball bearing, and a mechanism for connecting the motor and the pinion shaft and projecting the pinion shaft out of the motor housing to engage with a ring gear in a transmission casing of the engine thereby to rotate the ring gear and to start the engine when the engine is started. The mechanism includes a clutch for connecting an output shaft of the motor to the pinion shaft.

In a conventional starter of this type, as described in Japanese Patent Laid-Open No. 61-1864, for example, the motor housing is formed simply cylindrical around the peripheral portion of the pinion shaft, and the ball bearing for rotatably and slidably supporting the pinion shaft is fixed to the motor housing. The pinion shaft

is provided with a stepped portion at its outer periphery and inserted into the ball bearing so that the stepped portion of the pinion shaft abuts the side face of the ball bearing.

Provision of the stepped portion of the pinion gear abutting the ball bearing is to prevent entry of brine, dusts etc. into the sliding portion between the ball bearing and the pinion shaft so that rust occurrence will be prevented and a smooth sliding operation will be carried out.

The mechanism which accomplishes rust-proofing and dust-proofing by employing the conventional technique described above cannot completely cut off the invasion of brine, dust, etc., in an atmospheric gas when a pressure inside the transmission case rises and dirty atmospheric gas inside the transmission case flows into the motor housing, and if this starter is used for several years, defect occurs in the sliding operation of the pinion shaft and fixation of the pinion shaft onto the bearing sliding surface occurs disadvantageously. Further, in the conventional structure described above, after assembling the clutch, the pinion shaft and the ball bearing into the motor housing, this ball bearing is necessary to be fixed to the motor housing. Therefore, it is difficult to assemble the starter and the conventional technique cannot be easily applied to practical application.

Another construction is disclosed in Japanese Utility Model Laid-Open No. 64-29270 which is laid-open on February 21, 1989. This construction has an air space at one side of a bearing supporting a movable pinion shaft and an opening which is formed in a front machine frame and through which a pinion of the pinion shaft projects out of the machine frame. A flange portion (22) is formed at the opening to extend radially inwards to provide a small clearance between the an outer periphery of the pinion and the opening. The flange portion has a adjacent relation to a shoulder portion of the pinion shaft when the pinion project outside the frame whereby a clearance between the opening and the pinion is made small at the opening when the pinion projects.

The above construction further is provided a drain passage for discharge of a liquid entered the air space at the clearance into a transmission casing. Even in the above-mentioned construction, a problem is left such that pressure in the air space increases as time lapses, so that air in the a space is likely to penetrate into a sliding portion between the pinion shaft and the bearing and contaminate the sliding portion with dust, water, brine etc. contained in the air.

Summary of the Invention

An object of the present invention is to provide a contaninant-proof structure wherein a sliding member, a

support member for slidably supporting the sliding member and a structure for driving the sliding member can be assembled easily into a housing, and wherein occurrence of rust on a sliding surface or bearing portion of the support member, and a starter for engines employing such a structure.

An aspect of the present invention to carry out the object resides in a contaminant-proof structure for preventing a sliding portion of an apparatus from adhesion of contaminants hampering a smooth sliding operation such as dust, brine, etc.. The apparatus has a sliding member, disposed in a housing and supported by a support so that one end of the member is projectable out of the housing through a hole or opening made in the housing. The contaminant-proof or sliding portion prevention structure comprises dimensional shapes, of the housing opening and the end portion of the sliding member, formed so that a gap defined between the housing opening and the end portion of the sliding member inserted in the housing opening is reduced in dimension, a gas reservoir formed between the support member and a wall of the housing at the opening and having a space volume enough to reduce a flow speed of gas passing through the gap between the housing opening and the end portion of the sliding member inserted therein, and a communication passage for bypassing sliding surface of said support member and communicating the gas reservoir and a space at an opposite side of the sliding member to the gas reservoir side.

Preferably, the gas reservoir has a volume enough to make the gas entered the gas reservoir at the gap substantially stationary.

The communication passage is preferable to bypass the sliding portion of the support member and communicate with spaces at both sides of the support member such as a bearing supporting the sliding member over the sliding portion so that the pressure at both the side of the support can be made substantially equal and the sliding portion of the support member is not contaminated with dust and brine, etc..

A typical example of an apparatus employing such a sliding portion prevention structure as mentioned above is a starter for engines.

An aspect of the present invention, resides in a starter comprising a housing, a motor having an output shaft disposed in the housing, a rotatable shaft having a pinion formed at one end thereof, a support member for rotatably and axially slidably supporting the rotatable shaft, and a mechanism for connecting the rotatable shaft to the output shaft of the motor and projecting the rotatable shaft out of the housing through a hole formed in the housing to mesh with the pinion and a gear in a transmission casing of the engine to drive the engine, an air reservoir formed between a wall of said housing in which said opening is formed and one side of said support member opposing said housing wall, and a communication

passage provided for communicating said air reservoir and the outside of said housing through a space at an opposite side of the support member to said reservoir.

A termination of pinion teeth formed in the pinion shaft is between the opposite ends thereof, and preferably, the tooth termination faces an inner peripheral surface of the housing wall forming the opening when the pinon projects out of the housing whereby an amount of air entering the housing at the opening.

Brief Description of the Drawings

Fig. 1 is a sectional view of an embodiment of a starter in accordance with the present invention;

Fig. 2 is a sectional view showing the starter of Fig. 1 under the state where a pinion meshes with a ring gear to start the engine;

Fig. 3 is a front view of a part of the starter shown in Fig. 1;

Fig. 4 is a schematic view for explaining the condition of air flows inside the starter shown in Fig. 1;

Figs. 5 and 6 are diagrams showing the experimental data of a conventional starter; and

Figs. 7 and 8 are diagrams showing the experimental data of the starter shown in Fig. 1.

Detailed Description of the Invention

Hereinafter, an embodiment of the present invention will be explained with reference to the drawings. Incidentally, the embodiment will be explained by use of a starter which is often used under a deteriorated environment as a suitable example of the apparatus employing a structure for preventing a sliding portion of an apparatus from adhesion of substances hampering a smooth operation such as dust, brine, etc., but the present invention is not limited to the starter and the portions relating to the invention of this embodiment can of course be applied to apparatuses in general which have the structure as mentioned above.

Fig. 1 shows a starter in accordance with an embodiment of the present invention.

The starter 1 is provided with a motor housing 2 storing a motor (not shown) at a rear part thereof.

The motor housing 2 is fixed to a transmission casing 3 of an engine such as an internal combustion engine for automobiles so that a part of the housing 2 projects into the transmission casing 3. The motor disposed in the housing has an output shaft 4 projecting toward the transmission casing 3. The output shaft 4 is formed of a helical spline 5 at an intermediate part thereof. A hollow pinion shaft 7 has a pinion 16 formed at an end. The end of the hollow pinion shaft 7 is closed with a plate 7a fixed thereto and the other end opened. The

hollow pinion shaft 7 is fitted, from the open end side to the tip portion of the output shaft 4 through a metal bearing 6 in such a manner as to be capable of rotating and sliding in an axial direction.

The hollows pinion shaft 7 and the motor output shaft 4 are coupled integrally by a one-way clutch 8, and the clutch outer 9 of this one-way clutch 8 is disposed around the outer periphery of the helical spline 5 so that it meshes with the helical spline 5 of the output shaft 4. A roller 10 of the one-way clutch 8 is stored in a wedge-shaped gap defined between the clutch outer 9 and the outer periphery of the open end portion 11 of the hollow pinion shaft 7, so that when the clutch outer 9 moves to the right in Fig. 1 and rotates to follow up the rotation of the output shaft 4 through spline coupling, the roller 10 couples integrally the clutch outer 9 and the hollow pinion shaft 7.

The clutch outer 9 is axially shifted by a shift lever 12. One end of the shift lever 12 is connected to the clutch outer 9 and the other end is connected to a plunger 15 of the electromagnetic switch 14. The shift lever 12 is pushed on a wall of the motor housing 2 by force of a torsion spring 13. The outer peripheral surface of the pinion shaft 7 (hereinafter referred to also as the "sliding surface") is supported slidably in the axial direction by a ball bearing 17 which is press-fitted into and fixed to the motor housing 2. The ball

bearing 17 also has a sliding surface for slidably supporting the pinion shaft 7.

The motor housing 2 has an opening 18 for projection of the pinion shaft 7 out of the motor housing 2. The inner diameter of the opening 18 is made somewhat greater than the outer diameter of the sliding surface of the pinion shaft 7, that is, the inner diameter of the opening 18 and the outer diameter of the pinion shaft 7 are substantially the same. A dimensional relation between the pinion 16 formed in the pinion shaft 4 and the wall thickness of the motor housing 2 defining the opening 18 is decided so that when the pinion shaft 7 projects from the opening 18 into transmission casing 3, the termination or final edge 16a of the gear tooth of the pinion 16 faces the inner peripheral surface of the opening 18, whereby area of air passage formed between the pinion shaft end portion inserted in the opening 18 is very small when the pinion shaft 7 projects through the opening 18 into the transmission casing 3.

The motor housing 2 is formed to provide a ring-like atmospheric gas reservoir 19 such as an air reservoir between the side of the ball bearing 17 and the wall of the motor housing 2 at the side of the opening 18. The air reservoir 19 has a function that air flow passing through the air gap between the opening 18 and the pinion shaft 7 inserted in the opening 18 and entering the air reservoir 19 is reduced in speed. Preferably, the air

flow becomes substantially stationary in the air reservoir 19.

The motor housing 2 has a clutch storage chamber 20 at the opposite side to the air reservoir 19 with respect to the ball bearing 17. The air reservoir 19 communicates with the clutch storage chamber 20 through a communication passage 21. This communication passage 21 is disposed at a position which bypasses the sliding surface of the ball bearing 17, that is, at the position above the ball bearing 17 which is on the opposite side to the sliding surface of the ball bearing 17. The clutch storage chamber 20 as the communication destination of the passage 21 is communicated with the external air by a gap at each part which is not shown in the drawing but in order to insure reliable communication with the external air, an external communication port 22 is bored on the motor housing 2 in this embodiment.

In this embodiment, further, a ring-like partition 23 of a stainless sheet, for example, is disposed on the side surface of the ball bearing 17 on the side of the opening 18, that is, on the side surface on the side of the air reservoir 19, and a notch groove (see Fig. 3) 24 is disposed downwardly in the gravitational direction at the opening 18.

Incidentally, reference numeral 25 represents a ring gear disposed outside of the motor housing 2 and inside the transmission case 3. This ring gear 25 meshes with

the pinion 16 and is driven for rotation by the motor, and the engine is started.

Instead of the motor housing, a housing may be made independent of the motor and fixed to the motor so that an output shaft is disposed in the housing.

When the engine is started by the starter 1 having the construction described above, a starter switch not shown is turned on. Then, the electromagnetic switch 14 is turned on and the plunger 15 is attracted into the electromagnetic switch 14 as shown in Fig. 2. Upon the attraction of the one end of the shift lever 12 by the plunger 15, the shift lever 12 rotates about its contact point A with the motor housing 2 as the fulcrum, whereby the other end of the shift lever 12 connected to the clutch outer 9 is moved to the right and the pinion 16 projects from the opening 18 into the transmission casing 3 and meshes with the ring gear 25. As the starter switch is turned on, power is supplied to the motor and the output shaft 4 starts rotating. Due to both of these operations, the one-way clutch 8 is actuated, the pinion shaft 7 starts rotating integrally with the motor output shaft 4 and the ring gear 25 is driven for rotation.

Fig. 4 is a view which explains the flow of a gas in the starter described above and shows schematically each constitution portion of the starter.

When the ring gear 25 starts rotating at the start of the engine, an accompanying rotating gas flow a which

is caused with the rotation of this ring gear 25 is prevented from advancing at the meshing position between the ring-gear 25 and the pinion gear 16 and is about to flow into the starter 1, that is, into the motor housing 2, through the gap between its opening 18 and the pinion shaft 7. This inflowing gas flow b raises the pressure inside the air reservoir 19. In this embodiment, however, the dimensions and shapes of the opening 18, the pinion shaft 7 and the gear tooth termination 16a of the pinion 16 are determined so that the gap described above becomes extremely small. Therefore, this inflow is limited and the rise of the pressure inside the air reservoir 19 is limited. Further, the inflowing gas flow b is decelerated to be substantially stationary when it enters the air reservoir 19, and detrimental dust and water are collected in this air reservoir 19. The dust and water staying in this air reservoir 19 return into the transmission casing 3 through the notch groove 24.

The air flow that flows into the air reservoir 19 enters the substantially stationary state but if it is left as such, the pressure inside the air reservoir 19 rises. In this embodiment, however, the air inside the air reservoir 19 enters the clutch storage chamber 20 through the passage 21 (air flow c). In other words, the dirty air inside the transmission casing 3 that flows into the motor housing 2 flows into the clutch storage chamber 20 without contaminating the sliding surface of

the ball bearing 17. The air which flows into the air reservoir 19 in such a direction as to impinge directly against the ball bearing 17 is checked by the partition 23. In other words, the dust and water do not directly contaminate the ball bearing 17 and the sliding surface.

After the start of the engine, the starter switch is turned off. Accordingly, the supply of power to the motor is cut off, the pinion 16 stops rotation, the electromagnetic switch 14 is deenergized, the shift lever 12 is released from the attraction by the plunger by the force of the spring, and the pinon 16 disengages from the ring gear 25 and is returned into the motor housing 2.

When the number of revolution of the engine rises, the flow velocity of the accompanying rotation air flow a becomes high. Therefore, the pressure near the opening 18 of the motor housing 2 becomes lower than the pressure of the air reservoir 19 according to the Bernoulli's law, the air inside the air reservoir 19 is sucked out from the transmission casing 3 side and the interior of the air reservoir 19 attains a negative pressure. Accordingly, there occurs a gas flow d as the external air inside the clutch storage chamber 20 flows into the air reservoir 19 through the passage 21. This air flow d becomes an air flow e which flows from the high pressure portion near the passage 21 inside the air reservoir 19 to the low pressure portion near the notch groove 24. Accordingly, the interior of the air reservoir 19 is

filled with fresh and clean air and this air flow e pushes back the inflowing air flow b so that this air flow b is turned to the air flows f and g and is returned into the transmission casing 3. The air flow e flows out into the transmission casing 3 from the notch groove 24.

When the number of revolution of the engine further rises, the pressure inside the air reservoir 19 further drops and the operation of the air flows described above becomes more vigorous. Furthermore, the external air of the clutch storage chamber 20 generates the air flows h and i that are to flow into the air reservoir 19 through the gap between the ball bearing 17 and the pinion shaft 7 and these air flows h, i purge the dust and water that attempt to enter the sliding surface from the air reservoir 19.

Next, the effect of this embodiment will be explained by actual experimental data by the experimental data of the comventional starter will be first explained for comparison. The experimental data of the convetional starter are those of the starter which is not equipped with the air reservoir 19 and the passage 21 and take the pressure change near the ball bearing 17 when the number of revolution of the engine is raised to a high speed from an idle state after the start operation of the engine and is again returned to the idle state. According to the experimental data, a positive pressure of 8 mmAq occurs at the start of the starter and a negative pressure

becomes greater with the rise in the number of revolution of the engine and a maximum negative pressure of -15 mmAq occurs. Fig. 6 shows the pressure change when the starter switch is kept ON for four seconds, for example, in order to start this conventional starter. In this case, it can be understood that the inflow of the air flow b shown in Fig. 4 continues and the positive pressure state continues meantime.

Fig. 7 shows the pressure change in the air reservoir 19 in this embodiment. In this embodiment, too, the pressure becomes the positive pressure at the start of the starter, but its value is 3 mmAq. In other words, the inflow of the air flow b is less by the decrement of the positive pressure value than the conventional apparatus and the inflow quantity of the dust and water becomes smaller as much. In the case of the conventional apparatus, the possibilility of contamination of the sliding surface becomes higher if the ON state of the starter switch is kept for a longer time but in the case of this embodiment, the absolute value of the positive pressure itself is small and the possibility of contamination of the sliding surface is therefore small even when the ON state of the starter switch is kept for a long time.

In the case of this embodiment, even when the number of revolution of the engine rises and the pressure inside the air reservoir 19 becomes the negative pressure, its

maximum value is -9 mmAq. The fact represents that even when the air inside the air reservoir 19 is sucked out by the accompanying rotating air flow a, there is the air flow d of the external air that flows into the air reservoir 19 through the passage 21. In other words, it represents that this air flow d prevents the dirty air inside the transmission casing 3 from flowing into the air reservoir 19 and reaching the sliding surface.

The experimental data collected to demonstrate this fact are shown in Fig. 8. Fig. 8 shows the experimental data obtained by collecting the pressure change on the side surface portion of the ball bearing 17 among the air reservoir 19 simultaneously and in parallel with the experimental data of Fig. 7. According to this experimental data, the positive pressure of 2 mmAq occurs at the time of ON of the starter switch and the negative pressure of -2 mmAq occurs at the time of the high speed revolution of the engine. This fact represents that the air flows c and d flow through the passage 21. As a result of acceleration tests, the starter of this embodiment is confirmed to retain the sliding surface under the good conditions and to be free from any defect for at least 6 years and this is brought forth as the synergistic effect of the disposition of the air reservoir 19 and the disposition of the passage 21 which generates the air flows c, d represented by the experimental data described above.

As described above, in accordance with this embodiment, the rise of the positive pressure near the sliding surface at the time of the start of the engine is restricted, the pressure difference between the pressure inside the motor housing 2 and the pressure inside the transmission case 3 is regulated and the pressure gradient between them is brought close to substantially zero. Accordingly, the entrance of the dirty air inside the transmission casing 3 into the motor housing 2 is restricted and the sliding surface is prevented from being contaminated by the dust or is rusted by invasion of brine. Since the air flow that pushes back the dirty air which is about to flow into the sliding surface by the clean air at the time of driving of the engine is generated, the sliding surface can be kept likewise under the good condition.

Incidentally, this embodiment is equipped with the three elements, that is, the disposition of the air reservoir 19, the use of the dimensional shape for limiting the air flow a and the disposition of the passage 21, but the present invention is not limited thereto. Only the disposition of the air reservoir 19 and the passage 21 provide the dust-and rust-proofing effect, as is obvious from the explanation of the experimental data of the embodiment described above.

The present invention is not limited to the starter described above but when applied to machinery in general

equipped with the sliding member analogous to the slidable pinion shaft described in the embodiment, the present invention can prevent entrance of the dust and the like into the sliding portion.

CLAIMS:

1. A starter for engines, comprising:

a housing;

a motor having an output shaft disposed in said housing;

a rotatable shaft having a pinion formed at one end thereof;

a support member disposed in said housing for supporting said rotatable shaft rotatably and slidably in an axial direction thereof;

a mechanism for connecting said rotatable shaft to said output shaft of said motor and projecting said rotatable shaft outside said housing through an opening formed in said housing to cause said pinion of said rotatable shaft to mesh with a gear out of said housing thereby to start the engine,

wherein a gap formed between said hole of said housing and said end of said rotatable shaft inserted in said opening is small, an air reservoir is formed between a wall of said housing in which said opening is formed and one side of said support member opposing said housing wall, and a communication passage is provided for communicating said air reservoir and the outside of said housing through an opposite side of said support member to the reservoir side thereof.

2. A starter according to claim 1, wherein said support member is a bearing fixed to said housing for rotatably slidably supporting said rotatable shaft.

3. A starter according to claim 2, wherein said pinion formed in said rotatable shaft has a tooth termination between both ends of said rotatable shaft, and said tooth termination faces an inner periphery of said opening within the width of said wall, whereby a clearance for air passage defined between said opening of said housing and said rotatable shaft inserted into said hole is made small thereby to restrict air inflow into said housing therethrough.

4. A starter according to claim 3 wherein said communication passage bypasses a sliding surface of said support and communicates with spaces at both sides of said support member with respect to the axial direction, one of said spaces being said air reservoir, whereby pressure at the both sides of said support member is substantially equal to each other.

5. A starter according to claim 4, wherein said communication passage bypasses said sliding surface of said bearing through an upper portion of said housing over said bearing in the gravitational direction.

6. A starter according to claim 5, wherein said housing has a notch groove in the wall under said opening communicating with said opening so that contaminative substances contained in the air entered said air reservoir at said opening can be escaped therethrough.

7. A starter according to claim 3, wherein a partition is provided on one side of said bearing at the side of said air reservoir for preventing impingement of air flowing in said housing through said gap between said hole of said housing and said rotatable shaft inserted in said opening, on said bearing, to thereby to prevent entrance of the contaminative substance into a sliding portion of said bearing.

8. A starter for starting internal combustion engines, said starter comprising;

a motor;

a housing containing said motor;

a pinion shaft disposed in said housing, one end of said pinion shaft having a pinion formed therein, teeth of which extend from the end toward the opposite end and terminate at a tooth termination disposed between the opposite ends of said pinion shaft;

a bearing disposed in and fixed to said housing and supporting said pinion shaft rotatably and slidably in an axial direction;

a mechanism disposed in said housing for connecting said pinion shaft to said motor and projecting said pinion of said pinion shaft out of said housing through an opening formed in a side wall of said housing so that said pinion engages with a ring gear in a transmission casing of the engine when the engine is instructed to start;

wherein said tooth termination of said pinion shaft perpendicularly faces an inner peripheral surface of said side wall defining said opening when said pinion is projected out of said housing, so that an air gap between said pinion shaft and said opening of said housing is restricted to small one;

an air reservoir formed between said side wall of said housing and one side of said bearing opposite to said side wall, said air reservoir having a space volume enough to reduce flow speed of air passing through said gap irrespective of relative position of said pinion shaft to said opening of said housing; and

a communication passage communicating spaces at both sides of said bearing, one of said spaces being said air reservoir, and said communication passage bypassing a sliding surface of said bearing and communicating with atmosphere outside said housing.

9. A starter according to claim 8, wherein said communication passage bypasses said sliding surface of

said bearing at an upper side of said bearing, and a passage independent from said communication passage is formed in an under side of said opening of said housing for communicating a lower part of said air reservoir and outside of said housing.

10. A starter according to claim 9, wherein a partition is provided on an air reservoir side of said bearing for preventing a sliding portion of said bearing from adhesion of solid and/or liquid substances on said sliding portion.

11. In a starter for engines provided with a pinion shaft enclosed in a housing and having a pinion at one end, said pinion shaft being supported by a bearing and slid in an axial direction to project into a transmission casing through an opening of said housing and mesh with a ring gear inside said transmission casing when an engine is started, the improvement comprising:

an air reservoir defined between said bearing and said opening of said housing for storing air admitted therein through said opening; and

a communication passage for communicating said air reservoir with external air.

12. A starter according to claim 11, wherein said communication passage communicates said air reservoir with an external air chamber defined in said housing at

opposite side of said bearing to an air reservoir side thereby to reduce pressure difference between both the sides of said bearing to prevent air from flowing through a gap between said pinion shaft and said bearing.

13. A starter according to claim 12, further including a partition for partitioning said bearing and said air reservoir on the side surface of said bearing.

14. In a starter for engines provided with a pinion shaft enclosed in a housing and having a pinion at one end, said pinion shaft being supported by a bearing and slid in an axial direction to project into a transmission casing through an opening of said housing and mesh with a ring gear inside said transmission casing when an engine is started, the improvement comprising an air passage for guiding an air flow generated by revolution of said ring gear meshing with said pinion and passing through said opening into said housing to bypass a slidably supporting portion of said bearing and flow from said opening into an external air chamber formed in said housing at an opposite side of said bearing to said opening side, said passage having a large area portion enough to make the air flow substantially stationary between said opening and said bearing.

15. A starter according to claim 14, wherein a partition is provided so as to prevent the air flow into said bearing from said opening.

16. A contaminant proof structure of a sliding portion between a sliding member and a support member supporting said sliding member which are disposed in a housing so that said sliding member can project into the outside of said housing through an opening formed in a wall of said housing, said structure comprising:

an atmospheric gas reservoir disposed in said housing between said support member and said wall of said housing around said opening;

a communication passage for bypassing said sliding portion and communicating said atmospheric gas reservoir with an external atmospheric gas through a space at an opposite side of said support member to the atmospheric gas reservoir side; and

wherein said sliding member has a dimension such that gap between said opening and said sliding member inserted in said opening is small.

17. A structure according to claim 16, wherein said housing has a notch groove in the wall below said opening in the gravitational direction to release solid and/or liquid substances contained in the gas in said atmospheric gas reservoir.

18. A structure according to claim 16, wherein said communication passage bypasses the sliding portion of said support member through an upper portion over said sliding member.

19. A structure according to claim 18, wherein a partition is provided to cover a side face of said support member at the reservoir side thereby to avoid collision of said gas flowing into said housing against said bearing.

20. A starter for engines substantially as herein described with reference to and as shown in Figures 1-4 and 7, 8 of the accompanying drawings.

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